Licence Reference No.	Risk Assessment Methodology Stage and Step	Report Version
N/A	Stage 1 (PSA)	A.2 Final for Client

REPORT

Site 65 Pembroke to Ringsend 38 kV: Preliminary Site Assessment Report for Historic Fluid Filled Cable Loss

ESB Engineering and Major Projects

Submitted to:

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Executive Summary

ESB operates and maintains a large network of fluid insulated electrical cables across Ireland, with the majority (of fluid filled cables) located in urban settings across Dublin City and Cork City. Due to the location and age of the cables, they are often subject to third party interference and damage and/or corrosion and defects, which can potentially cause the cable fluid to leak into adjacent soil, groundwater, and/or surface water. This report focuses on a leak of approximately 126,309 L of cable fluid (linear alkyl benzene) from a 38 kV section of cable between Pembroke and Ringsend (Site 65).

The objective of the work was as follows:

- To assess the environmental and human health impact associated with legacy cable fluid loss.

This has been completed in a risk-based staged approach, consistent with the process described in "*Guidance on the Management of Contaminated Land and Groundwater at EPA Licenced Sites*" (EPA, 2013). We note that the section of cable assessed in this report does not form part of an EPA licenced site.

In order to provide ESB with this Preliminary Site Assessment report, Golder has completed the following:

- A Site walkover (200 m each way along the cable length from the indicative leak location, and laterally as required);
- A desk study of publicly available information; and
- A preliminary Conceptual Site Model (CSM).

The work has been completed in accordance with the scope provided in the proposal P19126590.P1.V0, dated 28 June 2019. No significant variations from this scope were required to complete the work.

The Preliminary Site Assessment approach is considered conservative as it seeks to identify the potential source, and a broad range of initially theoretical pathway and receptor linkages present for each Site. The preliminary CSM identified potential source, pathway, and receptor linkages that may be present at the Site or caused by the leak. A qualitative risk analysis and evaluation was completed on each potential pollutant linkage identified. It is noted that where a potential risk is identified at this stage it does not necessarily mean a risk is present but that further investigation is required to either confirm the presence or absence of the risk. Where a potential linkage has been classified as either low or very low in the risk assessment no further action has been recommended to address this linkage as the actual risks identified in the low and very low risks have been sufficiently assessed in the PSA.

Further investigation and analysis will be required to assess these potential pollutant linkages identified in this report. A summary of the findings is given below. Golder will produce a letter under separate cover recommending actions to address the below findings:

Summary of Findings

Potential pollutant linkages have been identified that could impact the identified receptors as follows:

- There is a potential high risk that free phase LAB may have migrated to the underlying aquifer;
- There is a potential moderate risk to the River Liffey from dissolved phase LAB migrating to the River Liffey in groundwater;

Summary of Findings
■ There is a potential moderate risk to residents living in basement apartments close to the spill area could be exposed to vapours.

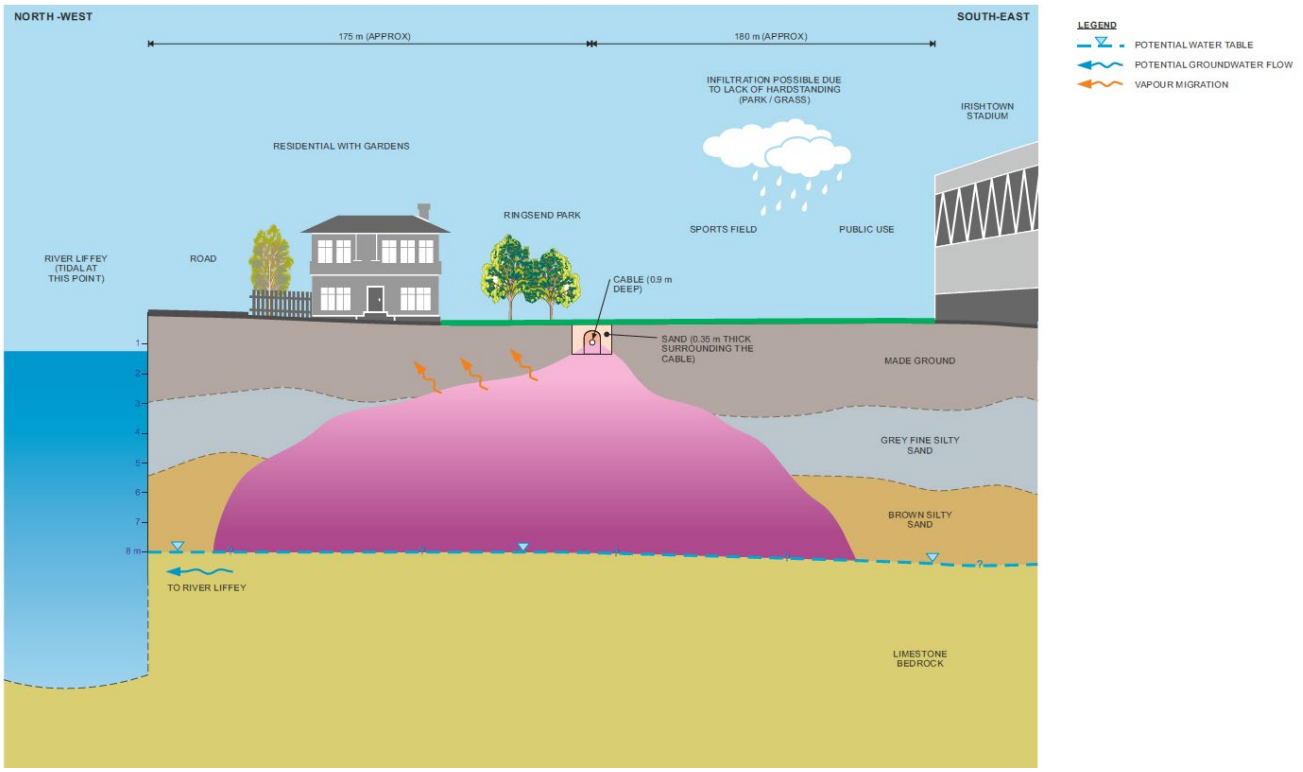

Figure 1: Preliminary CSM for Site 65 (Pembroke to Ringsend).

Summary of Report Status within the Overall Context of the Contaminated Land and Groundwater Site Assessment

EPA Contaminated Land and Groundwater Risk Assessment Methodology		Report Reference	Report Date	Status
Stage 1: Site Characterisation and Assessment				
1.1	Preliminary Site Assessment	19126590.65.A.2	24 April 2020	A.2 Final for Client
1.2	Detailed Site Assessment			
1.3	Quantitative Risk Assessment			
Stage 2: Corrective Action Feasibility and Design				
2.1	Outline Corrective Action Strategy			
2.2	Feasibility Study and Design			
2.3	Detailed Design			
2.4	Final Strategy and Implementation Plan			
Stage 3: Corrective Action and Implementation and Aftercare				

EPA Contaminated Land and Groundwater Risk Assessment Methodology		Report Reference	Report Date	Status
3.1	Enabling Works			
3.2	Corrective Action Implementation and Verification			
3.3	Aftercare			

Study Limitations

IMPORTANT: This section should be read before reliance is placed on any of the opinions, advice, recommendations or conclusions herein set out.

a) This report has been prepared for and at the request of ESB Engineering and Major Projects (the Client) for undertaking activities pursuant to its appointment of Golder Associates Ireland Ltd (Golder) to act as Consultant.

b) Save for the Client, no duty is undertaken or warranty or representation made to any party in respect of the opinions, advice, recommendations, or conclusions herein set out.

c) Regard should be had to the agreement between Golder and the Client which is taken to be the Golder proposal P19126590.P1.V0 dated 28 June 2019 and the revision P19126590.P1.V1 dated 3 July 2019, when considering this report and reliance to be placed on it.

d) All work carried out in preparing this report has used, and is based upon, Golders' professional knowledge and understanding of the current (July 2019) relevant Irish and European Community legislation, and assumptions set out in this report. Changes in the legislation or assumptions may cause the screening and methodology set out in this report to become inappropriate or incorrect. However, in writing this report, Golder has considered pending changes to environmental legislation and regulations of which it is currently aware. Following delivery of this report, Golder will have no obligation to advise the Client of any such changes, or of their repercussions.

e) Golder acknowledges that it is being retained, in part, because of its knowledge and experience with respect to environmental matters. Golder will consider and analyse all information provided to it in the context of Golders' knowledge and experience and all other relevant information known to Golder. To the extent that the information provided to Golder is not inconsistent or incompatible therewith, Golder shall be entitled to rely upon and assume, without independent verification, the accuracy and completeness of all such information and Golder shall have no obligation to verify the accuracy and completeness of such information. Golder has relied on the Client to provide information on spills, leaks, and other releases of materials to inform potential sources.

f) The content of this report represents the professional opinion of experienced environmental consultants. Golder does not provide specialist legal advice and the advice of lawyers will be required.

g) The scope of work includes interpretation of information from borings and test pits. Attention is drawn to the fact that special risks occur whenever engineering and related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with a professional Standard of Care may fail to detect certain conditions. The environmental, geologic, geotechnical, geochemical and hydrogeological conditions that Golder interprets to exist between sampling points may differ from those that actually exist. Passage of time, natural occurrences, and activities near the Site may substantially alter discovered conditions.

h) In the Conclusions section of this report and in the Executive Summary, Golder has set out its key findings and provided a summary and overview of its opinions. However, other parts of this report will often indicate the limitations of the information obtained by Golder and therefore any opinions set out in the Conclusions section and in the Executive Summary ought not to be relied upon until considered in the context of the whole report.

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Photographic record of site walkover

APPENDIX B
MSDS for T3788 (LAB)

APPENDIX C
CIRIA C522 Risk Analysis Definitions

1.0 INTRODUCTION

ESB Engineering and Major Projects (ESB) has commissioned Golder Associates Ireland Limited (Golder) to complete a Preliminary Site Assessment (PSA) for historical loss of fluid from a high voltage (38 kV) cable run located between Pembroke and Ringsend ('Site 65') (hereafter referred to as the 'Site').

The work has been completed by suitably qualified and experienced Golder consultants. The curriculum vitae of the Golder consultants who worked on this report are available on request.

1.1 Background

ESB operates and maintains a large network of fluid insulated electrical cables across Ireland, with the majority (of fluid filled cables) located in urban settings across Dublin City and Cork City. Due to the location and age of the cables, they are potentially subject to third party interference and damage and/or corrosion and defects, which can potentially cause the cable fluid to leak into adjacent soil, groundwater, and/or surface water. ESB has requested that Golder complete a preliminary risk assessment in accordance with the EPA document "*Guidance on the Management of Contaminated Land and Groundwater at EPA Licenced Sites*" (EPA, 2013).

The Preliminary Site Assessment approach is considered conservative as it seeks to identify the potential source, and a broad range of initially theoretical pathway and receptor linkages present for each Site. The preliminary CSM identified potential source, pathway, and receptor linkages that may be present at the Site or caused by the leak. A qualitative risk analysis and evaluation was completed on each potential pollutant linkage identified. It is noted that where a potential risk is identified at this stage it does not necessarily mean a risk is present but that further investigation is required to either confirm the presence or absence of the risk. Where a potential linkage has been classified as either low or very low in the risk assessment no further action has been recommended to address this linkage as the actual risks identified in the low and very low risks have been sufficiently assessed in the PSA.

1.1.1 Site Location

The location of the cable leak, and 200 m Site limits (200 m each way along the cable length from the cable leak) are summarised in Table 1 and shown on Drawing 1.

Table 1: Site Location

	Leak Co-ordinates	200 m Cable Length Limit	200 m Cable Length Limit
Easting	318644	318837	318445
Northing	233887	238855	233897

The Site is located in Ringsend Park in the urban area of Dublin, approximately 175 m south of the River Liffey. The leak occurred along a length of cable 800 m from Ringsend station.

1.1.2 Leak Information

The following information regarding the leak has been provided to Golder by ESB.

Table 2: Summary of Leak Information

Site ID	65
Incident Title	65 Pembroke to Ringsend – 2000

Circuit	Pembroke – Ringsend 38 kV
Leak Start Date	2000
Leak Repair Date	2003
Leak Duration (months)	48
Total Leakage (litres)	126,309
Leakage Rate (litres/month)	2,631
Volume of Circuit (litres)	5,757
Year Circuit Installed	1950
Voltage (kV)	38
Cable Length (km)	2.2
Leak Size Minus Circuit Volume (litres)	120,552
Assumed Fluid	Linear alkyl benzene (LAB)
Comment	Pre 1970 circuit. Leak size greater than circuit volume. Assume original fluid replaced.
Local Authority	Dublin City Council
Leak Location	800 m from Ringsend Station
Fluid/Oil Type	Cable fluid
Chemical Information	Linear Alkyl Benzene
Brand Name	T 3788
CAS Number	67774-74-7

No further historical reports or observations made at the time of the leak discovery or repair were available for review as part of this PSA.

1.2 Objectives

The objective of the work is as follows:

- To assess the environmental and human health impact associated with legacy cable fluid loss.

This has been completed in a risk-based staged approach, consistent with the process described in "*Guidance on the Management of Contaminated Land and Groundwater at EPA Licenced Sites*" (EPA, 2013).

1.3 Scope of Works

A summary of the scope of works proposed, which was developed following best practice guidance and relevant Irish legislation, is as follows:

- Desk study – summary of current and historical publicly available information and site-specific data (where available). This included a visit to Trinity College Dublin map library to collect relevant information;
- Site walkover – a walkover of the site was conducted by a suitably qualified Golder engineer, to identify visual or olfactory evidence of potential contamination or areas of concern. The Site walkover extended a minimum of 200 m along the cable length in each direction, and an appropriate lateral distance from the cable leak was determined following the presence of potential human health and/or environmental receptors and/or alternative potential contaminant sources; and
- Preliminary Risk Assessment – this includes the information gathered as part of the desk study and Site walkover, which has been used to determine a preliminary Conceptual Site Model (CSM) identifying the potential source, pathway, and receptor linkages, and next stage recommendations.

More details on the proposed scope of work task summarised are included in proposal (P19126590.P1/V.1).

The Site walkover was conducted with no significant deviations from the proposed methodology. The length of the cable run was accessible 200 m each way from the indicative leak location.

2.0 SITE DESCRIPTION

The Site walkover was completed on 10 July 2019. The Golder engineer walked along the length of the cable; 200 m from the leak location in each direction (shown on Drawing 1). Whilst it is not expected that significant impacts will be observed at ground level above the leak location, a walkover was carried out for completeness.

2.1 Description of Leak Event

The ESB has provided Golder with information on the estimated quantities and types of fluid lost as presented in section 1.1.2 above.

2.2 Current Site Conditions

2.2.1 Leak Location

No evidence of potential contamination from cable fluid/oily substances was observed at the indicative leak location during the Site walkover. Selected photographs of potentially relevant observations made during the Site walkover are provided in APPENDIX A with commentary.

2.2.2 Cable and Area in Proximity to Leak

No evidence of potential contamination from cable fluid/oily substances was observed along the total 400 m cable length (200 m each way from the leak location) that we examined during the Site walkover. Selected photographs of potentially relevant observations made during the Site walkover are provided in APPENDIX A with commentary.

3.0 SITE HISTORY

3.1.1 Information Sources

- The Geological Survey of Ireland (GSI) online map viewer – dcenr.maps.arcgis.com, accessed 18 July 2019;
- The Geological Society of Ireland (GSI) Groundwater Bodies Summary for Dublin: https://secure.dccae.gov.ie/GSI_DOWNLOAD/Groundwater/Reports/GWB/DublinGWB.pdf, accessed on 18 July 2019;

- Environmental Protection Agency (EPA) online map viewer - https://gis.epa.ie/EPAMaps/, accessed 18 July 2019;
- The National Monuments Service's Historic Environment Mapping Viewer - http://webgis.archaeology.ie/historicenvironment/, accessed 18 July 2019;
- The National Parks and Wildlife Service (NPWS) map data - https://www.npws.ie/maps-and-data, accessed 18 July 2019;
- The European Pollutant Release and Transfer Registers (E-PRTR) – http://prtr.ec.europa.eu, accessed 18 July 2019;
- The Geohive by Ordnance Survey Ireland – https://geohive/ie/, accessed 18 July 2019; and
- The Ireland Grid Reference - http://gridreference.ie/, accessed 18 July 2019.

Trinity Map Library was visited on 10 July 2019 to consult available historical maps relating to the indicative leak location, the 400 m cable length, and areas of interest located laterally from the cable run.

3.1.2 Potential Historical Sources

Historical activities that may have resulted in contamination sources are summarised in Table 3.

Table 3: Historical Activities within 500 m of the Site Boundary

Date	Detail
1864 (1:2,500)	■ Largely depicted as sea. ■ Two bathing areas are noted. ■ Not yet reclaimed land. ■ Pigeon House Road is outlined but no development.
1907-1908 (1:2,500)	■ Less densely packed residential along the west. ■ Bay View terrace is present. ■ Cambridge Avenue is not yet present. ■ Pumping station is marked to east, but no tanks are noted. ■ Sand noted to the southeast.
1935 (1:2,500)	■ Pumping station to the east along Pigeon House Road with tanks noted. ■ West of the site is dominated by a park area and residential buildings. ■ No warehouse is noted to northeast. ■ Sand area noted to southeast - partial reclamation.
1970 (1:1,000)	■ Pumping station still located to east but is a smaller scale. ■ Tanks and an electrical substation noted to the northeast.

Date	Detail
	■ Warehouse is still present to the northeast. ■ Residential buildings to the west and Ringsend Park noted.
1988 (1:1,000)	■ The area is mixed use including a large recreation area (Ringsend Park) in the centre, residential buildings to the west and an industrial area further east as well as open spaces. ■ Warehouse noted on Pigeon House Road to northeast with an electrical station noted on its eastern side. ■ Pumping station to east along Pigeon House Road (opposite Warehouse) and has tanks noted onsite. ■ An electrical station is noted on the pumping station complex.

4.0 CHEMICALS OF CONCERN

The information provided by ESB (summarised in Table 2) defines the chemical present in the cable fluid is Linear Alkyl Benzene (LAB) present in cable fluid T 3788 (CAS 67774-74-7). LAB is the Chemical of Potential Concern (COPC) discussed further in this PSA.

The European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. 9 of 2010) establish a new strengthened regime for the protection of groundwater in line with the requirements of the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC). Regulations 9(c)–(f) requires the Environmental Protection Agency to identify and publish a list of substances which are to be considered hazardous or non-hazardous and which the Agency considers to present an existing or potential risk of pollution.

The EPA published such a list of such substances in their guidance document "*Classification of Hazardous and Non-Hazardous Substances in groundwater*" (2010). In this document the EPA has classified four Linear Alkyl Benzene compounds as hazardous (CAS numbers 134211-53-3, 115963-94-5, 115733-08-9 and 96792-49-3) in groundwater. The LAB compound used by the ESB identified with CAS number 6777-74-7 is not classified in this list. It is noted that the EPA document referenced above states that only substances that have been reviewed may be classified as hazardous or non-hazardous. If a substance is yet to be reviewed, then it cannot be classified as non-hazardous. There may be several reasons that a substance has not been reviewed, such as a lack of data on toxicity or bioaccumulation. In this instance Golder consider that the LAB used by ESB is not classified by the EPA with respect to being hazardous or non-hazardous in groundwater.

The European Chemicals Bureau 1st Priority List (Volume 3) "Union Risk Assessment Report CAS No 67774-74-7" (1999) completed a risk assessment for LAB. The following conclusions about LAB were made in the report:

- In relation to incidental contact of workers with LAB there is no need for additional risk reduction measures beyond normal precautions for this material (such as correct use of PPE);
- It degrades aerobically;
- It is moderately volatile from water with a Henry's Law constant of 95 Pa.m^3/mol;
- It is highly adsorptive to soil particles;

- It was not classified as toxic or hazardous under the EU legislation at the time of report issue;
- It was not classified as a skin irritant under EU legislation at the time of report issue;
- It was not classifiable as an eye irritant under EU legislation at the time of the report issue; and
- It was not classified as a skin sensitiser under EU legislation at the time of the report issue.

4.1 Review of Material Safety Data Sheet

The Material Safety Data Sheet (MSDS) provided by ESB (H&R ESP, undated) to Golder identified the cable fluid as T 3788 which is a *"low viscosity compound based on a blend of linear alkyl benzenes that have side alkyl chains of 10 – 13 carbon atoms in length."* The MSDS is provided in APPENDIX B. A summary of the chemical properties for LAB as listed in the MSDS are as follows:

- Concentration range is 100%;
- Not classified as a dangerous substance in accordance with The Chemical (Hazard Information and Packaging for Supply) Regulations 2002;
- Clear, colourless liquid;
- Mild petroleum odour;
- pH not determined;
- Boiling point of 280 ˚C;
- Flash point of >135 ˚C;
- Not flammable (but will burn);
- Not explosive;
- Vapour pressure is low at 20 ˚C is <0.02 kPa;
- Density of 0.86 g/cm^{-3} at 20 ˚C;
- Insoluble in water; a solubility value of 0.041 mg/L has been reported in the literature;
- Low volatility;
- Vapour density is >1 (air = 1);
- Evaporation rate is not determined;
- Human effects include skin and eye irritant, nausea and vomiting following ingestion, and irritant of the mucous membranes, cause dizziness, headaches, and nausea if inhaled; and
- No specific environmental hazards under normal use conditions.

LAB is used and manufactured extensively, most commonly in the production of linear alkyl benzene sulphonates (LAS), which are used in household and industrial cleaners and detergents. LAB has minor uses as a solvent and binder in speciality applications namely, cable oil, paint, insulation, electricity, and printing. Up to 1 % of LAS is expected to be LAB as the consequence of incomplete conversion during manufacture (Fernandez et al., 2002). Due to the wide use of LAS as a detergent and the discharge of LAS into the domestic sewer, the ultimate receiving environment for LAS and LAB is often the aquatic ecosystem. Concentrations of 0.001 – 2.2 mg/l of LAB has been reported in effluent discharge waters from municipal sewage treatment plants (Europe) (Fernandez et al., 2002).

LAB is produced from petroleum derivatives: benzene and linear paraffins and forms a mixture of long-alkyl chain LAB, with the alkyl group in various ranges (EC, 1997). The LAB used by ESB contains an alkyl chain group restricted to the range of C_{10} – C_{13} carbon atoms, and which are produced under the Chemical Abstract Service (CAS) registration number: 67774-74-7.

The “LAB and Derivatives” REACH Consortia (ReachCentrum, 2012) list LAB as a “*substance of unknown variable composition, complex reaction products or biological materials*”, or ‘UVCB’, for the purpose of chemical classification, labelling, and registration in the information for suggested entry into the International Uniform Chemical Information Database (IUCLID).

LAB is less dense than water, and due to its insolubility, it is likely to act as a Light Non-Aqueous Phase Liquid (LNAPL) when in contact with water (e.g. groundwater or surface water).

5.0 ENVIRONMENTAL SETTING

5.1.1 Information Sources

Information regarding geology, hydrology, hydrogeology and environmentally sensitive areas for the Site and surrounding area has been primarily obtained from publicly available sources outlined in Section 3.1.1.

5.1.2 Topography

The Site lies at an elevation of approximately 4 m above Ordnance Datum (m AOD) according to Ireland Grid Reference. The local topography falls to the north towards the River Liffey.

5.1.3 Current Surrounding Land Use

A summary of land use surrounding the leak location is provided is Table 4.

Table 4: Summary of Current Surrounding Land Use

Direction from Leak Location	Description of Current Land Use
North	There is residential housing approximately 100 m north of Site.
East	There is residential housing approximately 160 m east of the Site. Ringsend ESB station lies approximately 800 m east of the Site.
South	The south of Site is dominated by residential and commercial buildings. Irishtown Stadium lies approximately 115 m southeast of the site. Open space is present beyond Sean Moore Road approximately 400 m southeast of the Site.
West	Ringsend playground lies approximately 320 m west of the Site, beyond which are residential and commercial buildings.

Overall the site is generally surrounded by residential areas and amenity grassland. The indicative leak location lies within a public park.

5.1.4 Current Waste Permits, IPC and IE Licences in Area of Site

A review of the data available on the EPA online maps shows that there is one surrendered Integrated Pollution Control (IPC) licenced facility approximately 440 m southeast of the Site held by Becbay Limited. Golder also checked the national Waste Collection Permit Office Database. There are no registered waste permit holders for processing of mineral oil or LAB containing fluids within 500 m of the Site.

5.1.5 Sensitive Ecological Receptors

A review of the data available on the National Parks and Wildlife Service (NPWS) map viewer shows that there are no special protection areas (SPAs), natural heritage areas (NHAs), or special areas of conservation (SAC) within 500 m of the Site. The nearest protected sites are the South Dublin Bay SAC (000210) and the South Dublin Bay and River Tolka Estuary SPA (004024) located approximately 830 m southeast of the Site. We note

that this report does not represent an ecological assessment and that if such assessments are required will be completed separately by a suitably qualified ecologist as appropriate.

5.1.6 Hydrology

5.1.6.1 Surface Water Features

The Site lies within the “Liffey and Dublin Bay” Water Framework Directive catchment. The nearest surface water feature is The River Liffey is located 175 m north of the Site. The South Dublin Bay is approximately 880 m southeast of site. The River Dodder is located approximately 620 m west of the spill location.

5.1.6.2 Surface Water Quality

According to the Transitional Water Quality map 2010-2022, the section of the River Liffey north of site is considered unpolluted and its transitional Waterbody WFD status is moderate. According to the EPA River Waterbodies Risk map, the River Liffey 175 m west of Site is at risk of deteriorating or being at less than ‘Good’ status under the Water Framework Directive. The River Waterbody WFD status of the River Dodder is moderate.

5.1.6.3 Surface Water Abstraction

The GSI online map viewer did not show any Group Water Scheme Abstraction points within a 500 m radius of the Site.

5.1.6.4 Discharges to Surface Water

A review of the data available on the EPA map register shows there are no Section 4 Discharges within a 500 m radius of the Site.

5.1.6.5 Surface Water Flooding

The Office of Public Works (OPW) flood maps do not show any past flood events within 500 m of the Site. The OPW flood maps indicate that approximately 115 m west of Site has a low probability of flooding from rivers (1 in 1000 chance of occurring or being exceeded in any given year). The OPW flood maps indicate that approximately 270 m west of site has a low probability of coastal flooding (1 in 1000 chance of occurring or being exceeded in any given year). The Rainfall Flood Extents map indicates sections of the park surrounding the Site are at high probability (1 in 10 chance of occurring or being exceed in any given year) to be directly flood by rainfall in a moderate rainfall event.

5.1.6.6 Pollution Releases to Land, Air and Water

The European Pollutant Release and Transfer Register (E-PRTR), compiles data on releases of pollutants and transfer of wastes for specified industries across the EU for 91 pollutants. LAB is not listed as a specified pollutant in this register.

5.1.7 Geology

5.1.7.1 Artificial Ground

The EPA National subsoils map shows that Made Ground deposits are present beneath the Site. The depth, according to a borehole approximately 95 m southwest from site, is to 2.44 m bGL (GSI reference R2825/92313). However, the thickness of made ground is expected to be variable at this Site.

5.1.7.2 Superficial and Bedrock Geology

The GSI Subsoils (Quaternary Sediments) maps shows the subsoil to be “urban”. A review of the Bedrock Geology 1:100,000 map (GSI) shows that the underlying bedrock geology to be Lucan Formation, also known as Calp. This is described as dark limestone and shale. These form part of the Dinantian Upper Impure Limestones.

5.1.7.3 Faulting

The Bedrock Geology 1:100,000 map (GSI) Faults map indicates that there are no faults within a 1 km radius of the Site.

5.1.8 GSI Borehole Logs

The nearest registered well or spring is located approximately 885 m southwest of Site but is not considered a receptor at that distance. The GSI geotechnical viewer showed a borehole located approximately 95 m southeast from Site which was drilled to a depth of 7.62 m below Ground Level (bGL) (GSI reference R2825/92313). The geology encountered was recorded as Fill - Made Ground to 2.44 m bGL, underlain by soft brown sand and clay to 4.27 m bGL, grey fine silty sand to 5.18 m bGL, and brown silty sand to 7.62 m bGL. A depth to groundwater was not recorded. A geotechnical borehole (R2194/B84717) drilled approximately 75 m south west of the leak location did not encounter bedrock to 13 m bGL.

5.1.9 Hydrogeology

5.1.9.1 Groundwater Vulnerability

The GSI Bedrock Aquifer map shows the Site and surrounding have low vulnerability to groundwater contamination. The bedrock aquifer is described as a locally important aquifer. According to GSI, this is bedrock that is moderately productive only in local zones and is capable of supplying locally important abstractions (smaller public water supplies, and group schemes).

5.1.9.2 Discharges to Groundwater

A review of the data available on the EPA map register shows there are no known Section 4 discharges to groundwater within 500 m of the Site.

5.1.9.3 Groundwater Group Water Scheme Abstraction Points

The GSI online map viewer did not show any Group Water Scheme Abstraction points within a 500 m radius of the Site. The Site does not lie within a groundwater source protection zone.

5.1.9.4 Groundwater Flow Directions

There is no published information on groundwater levels or flow direction for the area of the Site. It is anticipated that groundwater beneath the Site will flow in a generally northern direction towards the River Liffey or in an easterly direction towards Dublin Bay. However, this has not been confirmed at this time, with Site-specific data.

5.1.9.5 Groundwater Quality

The Groundwater Body (GWB) underlying the Site is known as the Dublin GWB. The Dublin GWB is approximately 837 km^2 in areal extent. The GSI classifies this GWB as poorly productive bedrock. According to the EPA Ground Waterbody Water Framework Directive (WFD) map, the groundwater waterbody status is classified as good. The groundwater is also listed as flowing through SAC species areas and habitats, and SPA habitats. This statement applies to the entire GWB and is not specific to the leak location. In Dublin City centre where this Site is located the utilisation of the GWB as a potable resource is considered to be low due to the availability of potable mains supply and the relatively poor yielding potential of the aquifer.

6.0 PREVIOUS SITE SAMPLING AND MONITORING DATA

ESB has confirmed that there is no Site sampling and monitoring data, or observation reports available for the Site.

7.0 PRELIMINARY CONCEPTUAL SITE MODEL

The PSA is the first tier of a risk assessment; the purpose of the PSA is to develop a preliminary Conceptual Site Model (CSM) for the Site and establish whether or not there are potentially unacceptable risks. The outcome of the PSA is a decision as to whether or not further action is needed.

7.1 Context of the PSA

This PSA is being conducted to assist ESB with managing its potential liabilities associated with the Site.

7.2 Development of the Preliminary CSM

A preliminary CSM has been established from the data obtained from the following sources:

- Publicly available data;
- Trinity College Dublin Map library;
- ESB provided data; and
- Site walkover observations.

In the definition that has become accepted by the environmental industries and regulators (and discussed in the EPA (2013) "*Guidance on the management of contaminated land*"), there are three components to consider when developing a CSM:

- The *source* is the COPC identified, specifically it is the leak of the known cable fluid;
- The *pathways* are any routes linking the source with the receptors (in which degradation processes may also occur); and
- The *receptors* are humans and controlled waters that are connected to the source by the pathways, such as soils, vapours, aquifers, surface watercourses, local supply boreholes, or springs. Whilst ecological receptors are not normally considered in preliminary risk assessment protected sites are considered here to flag any potential issues that may require further detailed assessment.

These three components are linked within a conceptual model for a Site. Should either one of the source, pathway, or receptor be absent from the site setting, the pollutant linkage is deemed not to be present therefore negligible risk will be posed to human health and/or controlled water environments.

7.3 Description of the Source

The source is the indicative leak location of the fluid filled cable (Eastings: 318644, Northing: 233887) (locations obtained from georeferenced ESB provided drawing, reference QD-354120-01-D460-001-038-000, dated 26 June 2019 (provided in Drawing 1). ESB estimate the total loss of cable fluid over the leak period as approximately 126,309 L. ESB has stated that the leak was repaired in 2013.

A summary of the source (LAB) is provided in Section 4.0.

7.4 Description of the Pathways

A description and summary of the potential pathways identified is provided in Table 5.

The trenches for the cable runs are likely to be the primary potential pathway for the cable fluid migrate away from the indicative leak location. Details of a typical cable trench construction (provided by ESB) is as follows:

- Depth to the base of trench 1,200 mm;

- Depth to top of cable 900 mm – 1,000 mm;
- Thickness of sand surrounding cables 350 mm;
- Width of trench 1,100 mm; and
- Backfill is either arisings or Clause 804 (gravel up to 75 mm diameter).

7.5 Description of the Receptors

A description and summary of the potential receptors identified is provided in Table 5.

Drawing 2 provides an overview of the source and potential sensitive receptors located within 1 km of the Site. Sensitive receptors comprise of human health risks (e.g. schools or hospitals), or risks to controlled waters (e.g. rivers or lakes). Groundwater receptors (unless a potable borehole abstraction point is identified) are not shown on Drawing 2.

7.6 Preliminary Conceptual Site Model Risk Analysis

The potentially significant source-pathway-receptor linkages present at the Site and surrounding area (200 m along the cable length from the indicative leak location each way, and up to 500 m laterally from the cable run) are summarised in Table 6.

The level of potential risk of the identified pollutant linkage to human health and/or controlled waters and protected species and natural habitats has been completed with reference to CIRIA guidance document C522 "*Contaminated Land Risk Assessment a Guide to Good Practice"* (2002). This document presents a qualitative framework for evaluating risk which is useful at the PSA stage, prior to intrusive investigations being completed. C522 presents a risk matrix that allows a qualitative expression of:

- Magnitude of a potential consequence (severity) of a risk occurring; and
- Magnitude of the probability (likelihood) of the risk occurring.

Table 5: Risk Matrix – Consequence versus Probability.

		Consequence (of risk being realised)			
		Severe	**Medium**	**Mild**	**Minor**
Probability (of risk being realised)	**High Likelihood**	**Very High Risk**	**High Risk**	**Moderate Risk**	**Moderate/Low Risk**
	Likely	**High Risk**	**Moderate Risk**	**Moderate/Low Risk**	**Low Risk**
	Low Likelihood	**Moderate Risk**	**Moderate/Low Risk**	**Low Risk**	**Very Low Risk**
	Unlikely	**Moderate/Low Risk**	**Low Risk**	**Very Low Risk**	**Very Low Risk**

A detailed description of the probability and consequence definitions is provided in CIRIA guidance document C522. These definitions are also provided in APPENDIX C. Golder has applied this methodology to the identified pollutant linkages for this Site and presented the findings in Table 6. Each identified pollutant linkage has been numbered and a qualitative risk rating applied to the linkage. Comments are provided for consideration of the risk evaluation for each linkage.

Table 6: Summary of the Preliminary Source, Pathway, Receptor Linkages (CSM)

Linkage Number	Source	Pathway	Receptor	Consequence of Risk Being Realised	Probability of Risk Being Realised	Risk Classification	Comments
1	Free-phase LAB from the cable leak	Migration along the cable trench through the permeable infill materials	1a) Groundwater and/or 1b) surface water: direct contact or adjacent to the trench, likely to act as a LNAPL	Medium	1a) Groundwater High Likelihood 1b) surface water- Likely	1a) Groundwater - High Risk 1b) Surface water - Moderate Risk	1a) Due to the period of the leak and the volume leaked, there is potential for LAB to have reached perched groundwater (in the Made Ground) or migrated to the bedrock aquifer due to the presence of sand and gravel and the volume of material leaked. 1b) The nearest surface water receptor to the indicative leak location is the River Liffey 175 m north. Due to the volume of LAB leaked The River Liffey is considered a potential receptor. It is noted however that the leak was repaired approximately 16 years ago giving an opportunity for biodegradation of LAB in the subsurface. LAB is not toxic to marine life, however it can bioaccumulate.
2	Free-phase LAB from the cable leak	Migration along other service trenches/pipes	2a) Groundwater and/or 2b) surface water: direct contact or adjacent to the trench, likely to act as a LNAPL	Medium	High Likelihood	2a) Groundwater - High Risk 2b) Surface water - Moderate Risk	2a) Due to the period of the leak and the volume leaked, there is potential for LAB to have reached perched groundwater (in the Made Ground) or migrated to the bedrock aquifer due to the presence of sand and gravel and the volume of material leaked. 2b) The nearest surface water receptor to the indicative leak location is the River Liffey 175 m north. Due to the volume of LAB leaked The River Liffey is considered

Linkage Number	Source	Pathway	Receptor	Consequence of Risk Being Realised	Probability of Risk Being Realised	Risk Classification	Comments
							a potential receptor. It is noted however that the leak was repaired approximately 16 years ago giving an opportunity for biodegradation of LAB in the subsurface. LAB is not toxic to marine life, however it can bioaccumulate.
3	Free-phase LAB from the cable leak	Migration along other service trenches/pipes	Mains water pipes	Minor	Unlikely	Very Low Risk	Mains water pipes remain in positive pressure, ensuring that any water in areas of damaged pipework/leaks is forced out from the pipe, rather than allowing ingress into the water pipes. At this time, LAB is not known to be aggressive to plastic or metal pipework, or cause leaching from plastic pipework.
4	Free-phase LAB from the cable leak	Volatilisation and migration of vapours, accumulation in subsurface ducts, services, cellars, basements etc via inhalation	Residents with basements/cellars	Medium	Likely	Moderate Risk	Residential buildings are located approximately 100 m North of the Site and are the nearest residential receptor. At this time, it is not known if LAB has migrated to building footings adjacent to the spill location or into building basements, although due to the volume of LAB leaked, it is considered possible at this time. LAB is not considered toxic.
5	LAB in unsaturated	Vertical and lateral migration of LAB	Direct contact with contaminated soil, inhalation and ingestion of dust	Minor	Low likelihood	Very Low Risk	The Site is located in Ringsend park and the cable run intersects a playground approximately 320 m west of the leak location. Considering that LAB is not

Linkage Number	Source	Pathway	Receptor	Consequence of Risk Being Realised	Probability of Risk Being Realised	Risk Classification	Comments
	soils from the cable leak	through the unsaturated zone	from recreational activities by public users (e.g. children in playground and passers-by)				classified as toxic, or hazardous to health, or a skin or eye irritant, the consequence of incidental contact is considered minor. Surface outbreaks were not observed during the site walkover and vegetative die back was not noted. This indicates a minimal opportunity for direct contact for park users.
6	LAB in unsaturated soils from the cable leak	Vertical and lateral migration of LAB through the unsaturated zone	Local residents (with gardens): plant uptake and consumption of homegrown produce	Minor	Low Likelihood	Very Low Risk	The nearest residential buildings are present 100 m north of the Site and the cable run is known to intersect two private gardens. Due to the volume of LAB leaked these residential areas are likely to be a receptor. However, the depth to the cables is 0.9 m bgl minimising the potential for plant uptake.
7	LAB in unsaturated soils from the cable leak	Infiltration of rain, leaching of contaminants, and vertical/horizontal migration of dissolved contaminants	Groundwater	Mild	Likely	Moderate /Low Risk	The area is not covered in hardstanding which may increase rainwater infiltration rates. The bedrock groundwater body is designated as 'poorly productive', but quality is 'good' and the bedrock aquifer is locally important and may be moderately productive in local zones. The depth to groundwater is unknown. Due to the period of the leak and the volume leaked, there is potential for the COPC to have reached perched groundwater (in the Made Ground) or migrated to the bedrock aquifer although aquifer vulnerability is low.

Linkage Number	Source	Pathway	Receptor	Consequence of Risk Being Realised	Probability of Risk Being Realised	Risk Classification	Comments
8	LAB in unsaturated soils from the cable leak	Volatilisation (low volatilisation) and migration of vapours, accumulation in subsurface ducts, services, cellars and basements etc via inhalation	Residents	Medium	Likely	Moderate Risk	At this time, it is not known if LAB has migrated to building footings adjacent to the spill location or into building basements, but it is considered possible due to the volume of LAB leaked. LAB is not considered toxic. .
9	LAB in unsaturated soils from the cable leak	Volatilisation (low volatilisation) and migration of vapours, accumulation in subsurface ducts, services, cellars and basements etc via inhalation	Residents exposed to vapours in basements	Medium	Likely	Moderate Risk	At this time, it is not known if LAB has migrated to building footings adjacent to the spill location or into building basements, but it is considered possible due to the volume of LAB leaked. LAB is not considered toxic.
10	LAB in groundwater from the cable leak (low solubility)	Dissolution of contaminants, vertical and lateral migration of dissolved	10a) Groundwater Impacts to the groundwater body beneath the Site which has currently "Good" status and/or	Medium	10a) Groundwater - Likely 10b) Surface water - Low likelihood	10a) Groundwater - Moderate Risk 10b) surface water -	10a) The bedrock aquifer is locally important and may be moderately productive in local zones. The depth to groundwater is unknown. Due to the period of the leak and the volume leaked, there is potential for the COPC to have reached perched groundwater (in the Made Ground) or migrated to the bedrock aquifer

Linkage Number	Source	Pathway	Receptor	Consequence of Risk Being Realised	Probability of Risk Being Realised	Risk Classification	Comments
		contaminants in groundwater	10b) surface water: direct contact or adjacent to the trench.			Moderate/ Low Risk	due to the presence of sand and gravel although the aquifer vulnerability is low. The leak was repaired approximately 16 years ago offering a period of time for degradation of LAB in the subsurface. 10b) The nearest surface water receptor to the indicative leak location is the River Liffey 175 m north. Due to the volume of LAB leaked The River Liffey is considered a potential receptor. It is noted however that the leak was repaired approximately 16 years ago giving an opportunity for biodegradation of LAB in the subsurface. LAB is not toxic to marine life however it can bioaccumulate.

Notes: PPE = Personal Protective Equipment.

Drawing 3 provides a visual representation of Table 6, and highlights the potential pollutant linkages identified in the preliminary CSM assessment.

As defined in the guidance, risk is only realised when a linkage is proven between the source, pathway, and receptor. The linkage must be present between all three elements for a risk to be realised. Risk due to short term exposure, for example ground workers, are not considered here as they should be managed by appropriate use of PPE or other measures identified in a contractors Risk Assessment and Method Statement (RAMS) documents. During the risk analysis, Golder reviewed several relevant source, pathways, and receptors, and subsequently discounted the risks shown in Table 7, as there are incomplete linkages i.e. a potential risk not possible for a given scenario.

Table 7: Summary of Incomplete Source, Pathway, Receptor Linkages Considered

Source	Pathway	Receptor	Pollutant Linkage Identified?
126,309 L LAB from cable approximately 0.9 m deep, 800 m from Ringsend Station.	Dust and soil (from near surface soils) ingestion – area covered by hardstanding and leak occurring approximately 0.9 m from surface.	Short-term Public (i.e. passers-by, not workers)	Pathway linkage not viable
126,309 L LAB from cable approximately 0.9 m deep, 800 m from Ringsend Station.	Dermal contact (from near surface soils) – area covered by hardstanding and leak occurring approximately 0.9 m from surface (not in contact with surface soils).	Short-term Public (i.e. passers-by, not workers)	Pathway linkage not viable
126,309 L LAB from cable approximately 0.9 m deep, 800 m from Ringsend Station.	Dust (from near surface soils) inhalation – area covered by hardstanding and leak occurring approximately 0.9 m from surface.	Short-term Public (i.e. passers-by, not workers)	Pathway linkage not viable
126,309 L LAB from cable approximately 0.9 m deep, 800 m from Ringsend Station.	Migration in groundwater - the closest protected site is the Dublin Bay South SAC. The groundwater flow direction is not defined for the Site; however, the distance from the source to the SAC is 880 m.	Protected sites; Dublin Bay South SAC / pNHA	Pathway linkage not viable
126,309 L LAB from cable approximately 0.9 m deep, 800 m from Ringsend Station.	Volatisation and migration of vapours, accumulation in underground ducts, services, cellars and basements	Ground workers – Short term exposure risk is not assessed in the PSA as it is outside the scope of this report. Short term exposure risks to workers are assessed as part of the	Short term exposure risks not examined in the PSA which deals with long term (chronic) risks to receptors

Source	Pathway	Receptor	Pollutant Linkage Identified?
		Health and Safety Risk assessment (RAMS). Standard PPE measures apply for workers engaged in groundworks in Made Ground to minimise contact with potential contaminants and additional measures are not considered necessary.	

8.0 RISK EVALUATION

Potential pollutant linkages that could impact the identified receptors have been identified in the Preliminary CSM assessment. These linkages have been identified where the source, pathway, and receptor are all present and potentially viable, and the source is therefore considered to pose a theoretical risk to the identified receptors.

It is recognised that the initial leak volume was significant (126,309L) however the leak was repaired in 2003 giving 16 years of biodegradation potential in the subsurface.

Golder recognises that at present the ability of LAB to penetrate water pipes is not a fully understood risk, albeit likely to be a low risk. In the event that LAB was able to penetrate water pipes, then it is possible to examine the potential for LAB to dissolve in the water in the pipes and compare this to potential toxicity and drinking water limits (if available).

The WHO drinking water guideline value for EC_{10}–EC_{12}, EC_{12}–EC_{16} aromatic fraction (*Petroleum Products in Drinking-water, Background document for development of WHO Guidelines for Drinking-water Quality, 2008*) is 0.09 mg/l. The solubility limit of LAB is 0.041 mg/L (OECD). Therefore, it is not possible for LAB to dissolve into water in supply pipes above the drinking water limit i.e. the drinking water guidance cannot be exceeded. Furthermore, presuming permeation of LAB through the pipe is occurring, the maximum solubility limit (0.041mg/l) could potentially be reached if water within the pipe was stagnant and allowed to fully dissolve or equilibrate over time; however, Golder understands that water will be moving in the pipe making it difficult for LAB to reach its solubility limit.

Accordingly, the probability of the risk would be considered unlikely i.e. pollutant linkage may be present in such a scenario, but the circumstances under which harm would occur are improbable. Therefore, along with a medium potential hazard, this would result in an overall rating of ‘Low Risk’.

Based on the volume of LAB lost there is a potential for free phase LAB to contact the aquifer underlying the site and at present we consider this to be the most significant risk in relation to his loss of cable fluid. Overall the potential aquifer resource is recognised as poorly productive and unlikely to be used as a resource in this urban setting however there is potential for the aquifer to be impacted.

8.1 Conclusions

Due to the known leak of cable fluid into the subsurface, and the unknown characteristics (e.g. permeability) of the Made Ground likely to be surrounding the trench, there is the potential for lateral and vertical migration to the underlying aquifer. This is considered to be the primary risk driver for this Site at present.

Golder will present recommendations to address the potential risks under separate cover.

9.0 REFERENCES

CIRIA (2002) “Contaminated Land Risk Assessment a Guide to Good practice” (C522).

Environmental Protection Agency (EPA) (2013) “Guidance on the Management of Contaminated Land and Groundwater at EPA Licenced Sites”.

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Fernandez, C., Alonso, C., Garcia, P, Tarazona, J.V., Carbonell, G. (2002) *Toxicity of Linear Alkyl Benzenes (LABs) to the Aquatic Crustacean Daphnia magna through Waterborne and Food Chain Exposures.* Bulletin for Environmental Contamination and Toxicology, vol 68, issue 5, pp 637-643.

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Signature Page

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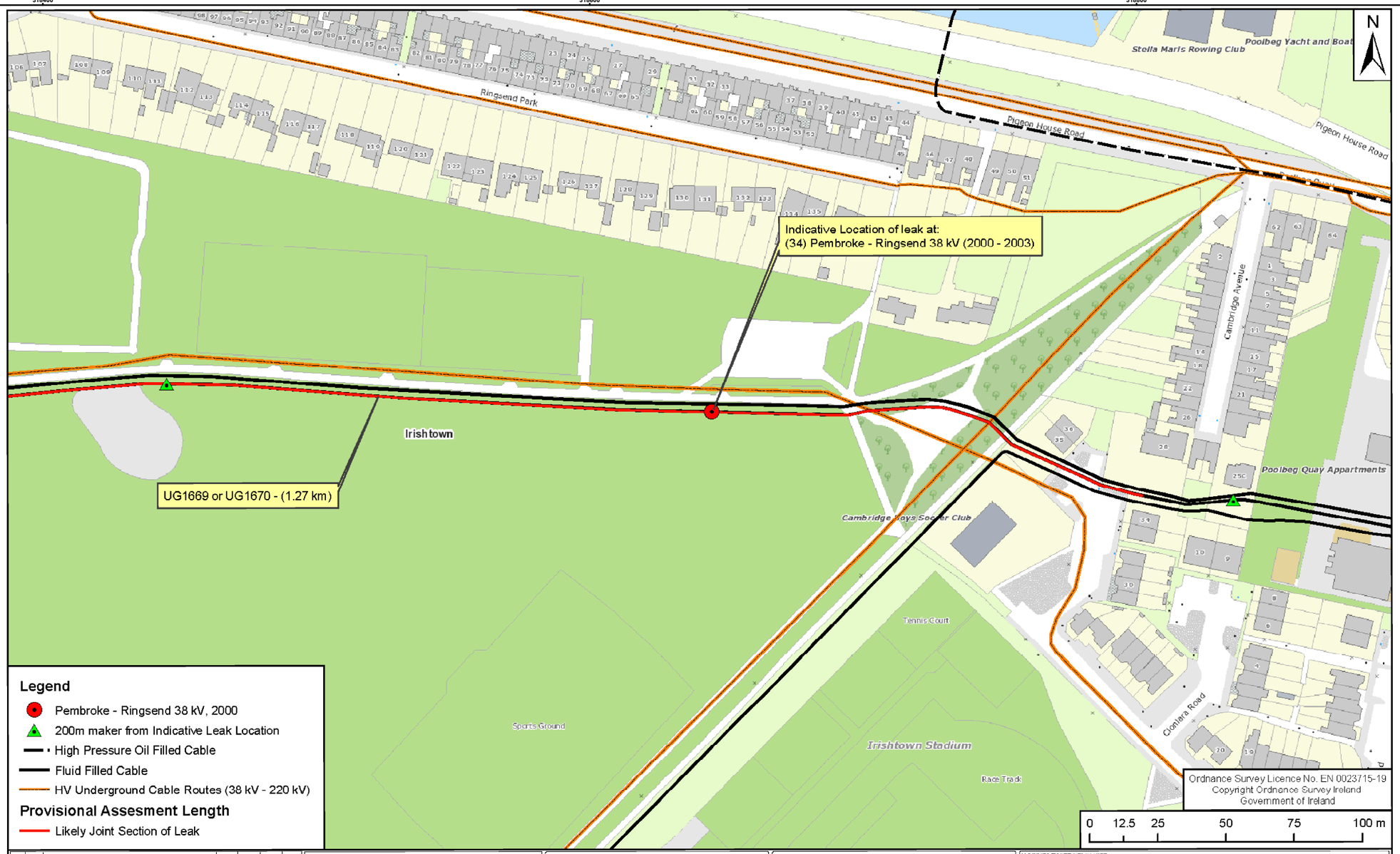
Directors: S. Copping, A. Harris, DRV Jones
VAT No.: 8297875W

Drawings



REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	APP
1	26/06/19	ADDITIONAL SPATIAL INFORMATION ADDED	T.O'R	T.O'R	J.F	A.M.C
0	26/06/19	REQUEST FOR PROPOSAL	T.O'R	T.O'R	J.F	A.M.C

CLIENT APPROVAL ☐ PLANNING ☐ TENDER ☐ CONSTRUCTION ☐ AS-BUILT ☐

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CLIENT: ESB Networks

PROJECT: P.R.A.

CONTRACT

PRODUCTION UNIT: Civil & Environmental Engineering

DRAWING TITLE: Indicative Cable Fluid Leakage Locations & Cable Sections (34) Pembroke - Ringsend 38 kV (2000 - 2003)

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DRAWN	PRODUCED	VERIFIED	APPROVED	APPROVAL DATE
T.O'Rourke	T.O'Rourke	J. Fitzpatrick	A.M. Casey	26/06/2019

CLIENT REF.	Revision	NO. OF SHEETS	SIZE	SCALE
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DRAWING NUMBER: QD-354120-01-D460-001-038-001

DRAFT
FOR ISSUE

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1:1,600 METRES

REFERENCE(S)
1. COORDINATE SYSTEM: TM65 IRISH GRID

CLIENT
ESB

PROJECT
ENVIRONMENTAL ASSESSMENTS OF ESB NETWORKS
HISTORIC FLUID FILLED CABLE LOSS

CONSULTANT
GOLDER

YYYY-MM-DD	2019 JUL 08
DESIGNED	KP
PREPARED	KP
REVIEWED	TM
APPROVED	EMCA

TITLE
SITE LOCATION - SITE 65

PROJECT NO.	CONTROL	REV.	DRAWING
19126590	600-SW-030	B.0	1

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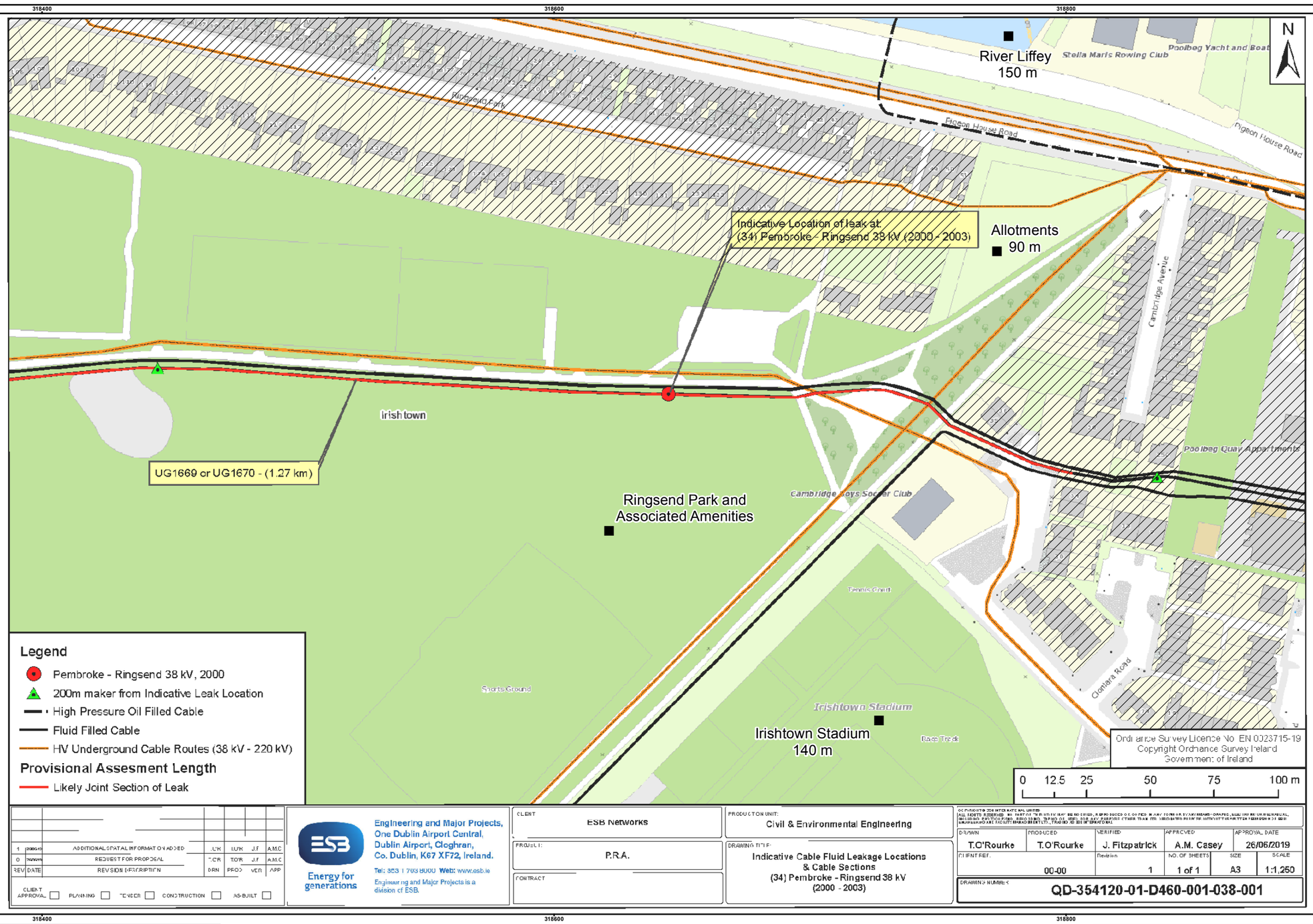

LEGEND

- ■ Receptor
- ⁄⁄⁄ Residential Housing with Garden

Distance	Direction	Receptor Description
90	NE	Allotments
150	N	River Liffey
350	NW	Ringsend College
620	SW	River Dodder
0	-	Ringsend Park and Associated Amenities
140	SE	Irishtown Stadium

DRAFT

FOR ISSUE

0 50 100

1:1,600 METRES

NOTE(S)

1. * SITE ID NUMBERS MAY NOT MATCH ESB ISSUED MAP AS NEW ID NUMBERS HAVE BEEN ISSUED.

REFERENCE(S)

1. COORDINATE SYSTEM: TM65 IRISH GRID

CLIENT
ESB

CONSULTANT
GOLDER

YYYY-MM-DD	2020 JAN 17
DESIGNED	KP
PREPARED	KP
REVIEWED	GF
APPROVED	TM

PROJECT
ENVIRONMENTAL ASSESSMENTS OF ESB NETWORKS
HISTORIC FLUID FILLED CABLE LOSS

TITLE
PRELIMINARY SOURCE – PATHWAYS – RECEPTORS IDENTIFIED

PROJECT NO.	CONTROL	REV.	DRAWING
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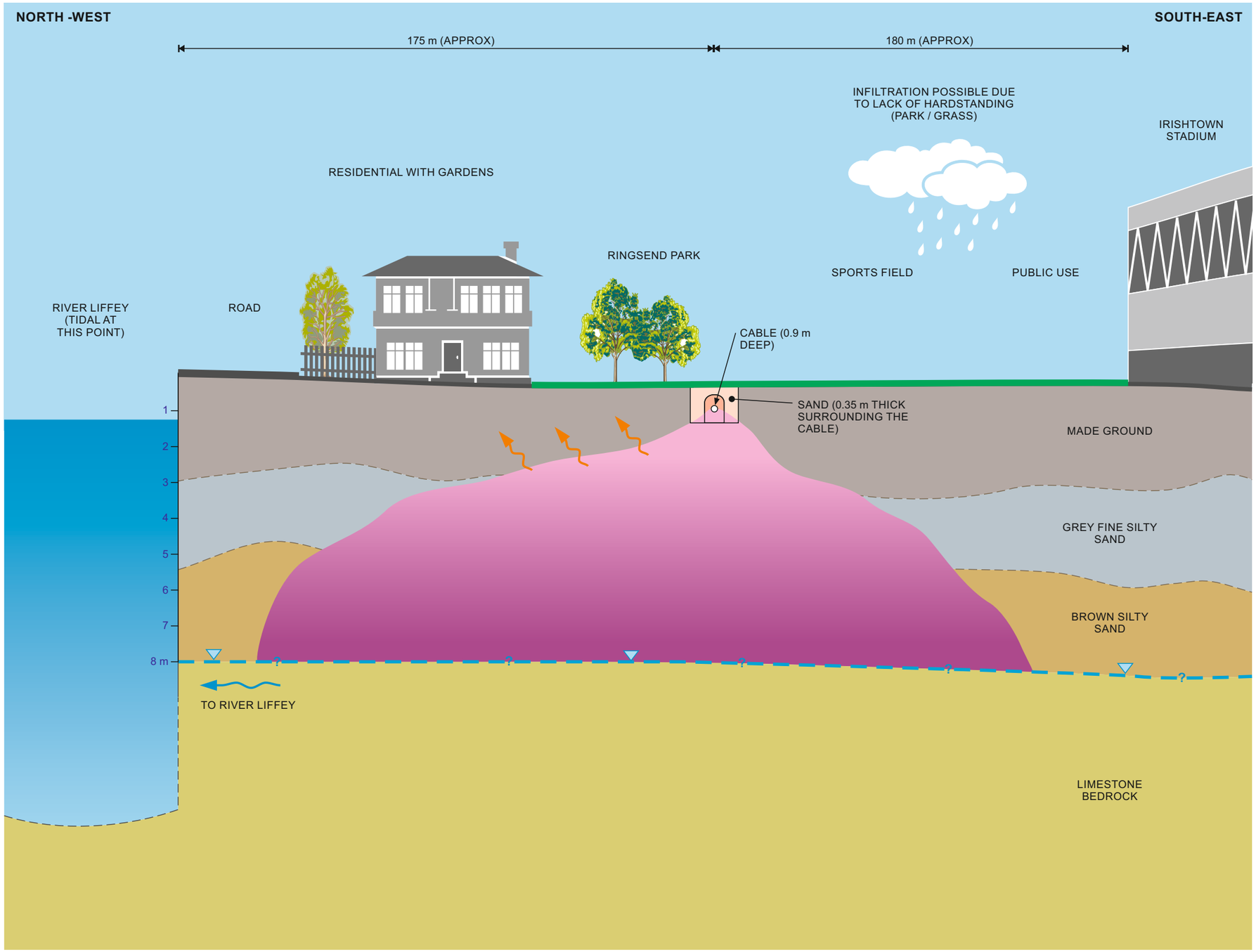

LEGEND

- POTENTIAL WATER TABLE
- POTENTIAL GROUNDWATER FLOW
- VAPOUR MIGRATION

CLIENT
ESB

CONSULTANT
GOLDER

YYYY-MM-DD	2019-08-23
PREPARED	ECS
DESIGN	EMcA
REVIEW	EMcA
APPROVED	TM

PROJECT
ENVIRONMENTAL ASSESSMENTS OF ESB NETWORKS HISTORIC FLUID FILLED CABLE LOSS

SHEET TITLE
PRELIMINARY CSM (IDENTIFYING POLLUTANT LINKAGES) PEMBROKE TO RINGSEND (SITE 65)

PROJECT NO	CONTROL	REV	DRAWING
19126590	1001-EA-0065	B	3

APPENDIX A

Relevant Photographs Recorded During the Site Walkover

65-01 – Mature tree stands are located along the southern areas of the Ringsend Park footpath and at the Site. Die back was not observed

65-02 – Potential for developed and mature root systems interacting with underlying services. Die back was not observed

65-03 – Potential for developed and mature root systems interacting with underlying services. . However die back was not observed

65-04 – Potential for developed and mature root systems interacting with underlying services. However die back was not observed

APPENDIX B

MSDS for T 3788 (LAB)

MATERIAL SAFETY DATA SHEET

1: IDENTIFICATION OF THE SUBSTANCE / PREPARATION AND OF THE COMPANY / UNDERTAKING

Product Name: T 3788

Application: Hollow-core Energy Cable Saturant

Company: H&R ESP Ltd.

Address: Matrix House
North 4th Street
Milton Keynes, MK9 1NJ
United Kingdom

Telephone: +44 (0)1908 351 111 Fax: +44 (0)1908 351122

2: COMPOSITION / INFORMATION ON INGREDIENTS

Composition: Low viscosity compound based on a blend of linear alkyl benzenes that have side alkyl chains of 10 – 13 carbon atoms in length.

Synonyms: Linear Alkyl Benzenes
Alkyl C10-C13, benzenes
Benzene, C10-13-alkyl-deriv.
Detergent Alkylate

Composition	EINECS number	CAS number	Symbol letters	Risk numbers	Concentration range
C10 – C13 Linear Alkyl Benzenes	267-051-0	67774-74-7	Not regulated		100%

All constituents of this product are listed in EINECS (European Inventory of Existing Commercial Chemical Substances) or ELINCS (European List of Notified Chemical Substances) or are exempt.

3: HAZARDS IDENTIFICATION

Classification of preparation: This product is not classified as a dangerous substance / preparation in accordance with The Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (CHIP3).

Physical and Chemical Properties: Not classified as flammable, but will burn. Avoid contact with strong oxidisers.

Health Effects

Skin:	Contact with the skin may cause irritation. Prolonged or repeated skin contact may cause drying of the skin, progressing to dermatitis. Symptoms may include itching, discolouration, swelling and blistering.
Eyes:	Contact with the eyes may cause irritation. Symptoms may include reddening, swelling and impaired vision.
Ingestion:	Ingestion of small amounts may cause nausea and vomiting.
Inhalation:	Due to low volatility, this product should not present an inhalation hazard under ambient conditions. Exposure to vapour or mineral oil mists may irritate the mucous membranes and cause dizziness, headaches and nausea.

Environmental Effects

No specific hazards under normal use conditions.

4: FIRST AID MEASURES

Inhalation:	Remove from further exposure. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance and call a doctor. If breathing has stopped, administer artificial respiration.
Skin contact:	Remove contaminated clothing and wash affected skin with soap and water. If persistent irritation occurs, obtain medical attention. If high pressure injection injuries occur, obtain medical attention immediately.
Eye contact:	Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention.
Ingestion:	Wash out mouth with water and obtain medical attention. DO NOT INDUCE VOMITING.

5: FIRE FIGHTING MEASURES

Suitable extinguishing media:	Carbon dioxide (CO_2), dry chemical, foam or water spray.
Unsuitable extinguishing media:	Do not use water jets.
Special exposure hazards:	Combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates and gases, including carbon monoxide, and unidentified organic and inorganic compounds.
Special protective equipment:	Proper protective equipment including breathing apparatus must be worn when approaching a fire in a confined space.

6: ACCIDENTAL RELEASE MEASURES

Personal Precautions:	Spilt product presents a significant slip hazard. Remove any sources of heat.
Environmental Precautions:	Prevent from spreading or entering into drains, sewers and watercourses by using inert absorbent material or other appropriate barriers. Inform local authorities if this cannot be prevented.
Methods for cleaning up:	Absorb liquid with inert absorbent material. Sweep up and remove to a suitable, clearly marked container for disposal in accordance with local and national regulations

7: HANDLING AND STORAGE

Handling:	Do not eat, drink or smoke whilst using this product. To avoid the possibility of skin disorders repeated or prolonged contact with products of this type must be avoided. It is essential to maintain a high standard of personal hygiene.
Storage:	Store in a cool place away from sources of heat and out of direct sunlight to avoid pressure build up. Do not store near oxidisers.

Handling and Storage Materials and Coatings

Suitable:	Carbon steel, baked epoxy or Phenolic coatings, aluminium.
Unsuitable:	Natural rubber, Butyl rubber

8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Limits:	Not established.
Engineering control measures:	Use of local exhaust ventilation is recommended whenever this product is used in a confined space, is heated above ambient temperatures, or is agitated.
Hygiene measures:	Wash hands before eating, drinking, smoking and using the toilet. Gloves should be washed before being removed.
Respiratory Protection:	Normally not required if adequate ventilation is in place. Where concentrations in air may exceed the limits given in this section, it is recommended to use a half mask respirator to protect from over exposure by inhalation. Suitable filter material depends on the amount and type of chemicals being handled, but filter material suitable for organic vapours may be considered for use.
Hand Protection:	When handling this product it is recommended to wear chemical resistant gloves. Suggested materials for protective gloves include: PVC, Neoprene or similar.
Eye Protection:	Wear eye protection such as safety glasses, chemical goggles, or face shield if engineering controls or work practices are not adequate to prevent eye contact. Have suitable eye wash water available.

Skin Protection:	Wear impervious protective clothing to prevent skin contact. Selection of protective clothing may include gloves, apron, boots, and complete facial protection depending on operations conducted.

9: PHYSICAL AND CHEMICAL PROPERTIES

General Information

Appearance:	Clear, colourless liquid
Odour:	Mild petroleum odour

Health, safety and environmental information

pH:	Not determined
Boiling point/range:	280°C
Flash point:	>135°C
Flammability:	Non flammable
Explosive properties:	Not explosive
Oxidising properties:	Not applicable
Vapour pressure at 20°C:	<0.02 kPa
Density:	0.86 g/cm^{-3} at 20°C typical
Solubility in water:	Insoluble
Kinematic Viscosity at 20°C:	4.0 – 4.5 cSt (4.0 – 4.5 mm^2/s) typical
Vapour density (Air=1):	>1
Evaporation rate:	Not determined

Other information

Pour point:	-60°C typical
Expansion coefficient:	0.0007 /°C typical
Neutralisation value:	0.03 mg KOH g^{-1} maximum

10: STABILITY AND REACTIVITY

Chemical stability:	This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure and will not polymerise.
Conditions to avoid:	Temperatures above 140°C
Materials to avoid:	Strong oxidising agents, such as liquid chlorine, concentrated oxygen, sodium hypochlorite, calcium hypochlorite, peroxides etc, as this may present an explosion hazard.
Hazardous decomposition products:	Carbon monoxide and irritant fumes may be generated if this product is burned in an enclosed space.

11: TOXICOLOGICAL INFORMATION

Basis for assessment:	Toxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the toxicology of similar products.
Acute toxicity:	Oral LD50 expected to be >5000 mg/kg (rat) Inhalation LC50/4hr expected to be >1.8 mg/l (rat) Dermal LD50 expected to be >2000 mg/kg (rabbit)
Corrosivity/irritation:	
Eye:	May be slightly irritant
Skin:	May be slightly irritant
Respiratory tract:	If mists are inhaled, slight irritation of the respiratory tract may occur
Skin sensitisation:	Not expected to be a skin sensitiser
Repeated-dose toxicity:	Prolonged and/or repeated contact may lead to irritation and possibly dermatitis, especially under conditions of poor personal hygiene.
Mutagenicity:	Not expected to be a mutagen.
Carcinogenicity:	Not expected to be a carcinogen.
Reproductive toxicity:	The preparation has not been assessed at all for this end-point, so its hazardous property in this regard is not known.

12: ECOLOGICAL INFORMATION

Basis for assessment:	Ecotoxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the ecotoxicology of similar products.
Ecotoxicity:	Poorly soluble mixture. Product is not expected to be ecotoxic to fish/daphinia/algae, or sewage bacteria. This preparation is expected to be removed in a wastewater treatment facility
Mobility:	Liquid under most environmental conditions. Floats on water. If it enters soil, it will adsorb to soil particles and will not be mobile.
Persistence and degradability:	Readily biodegradable. Soils degradation – half life approx. 15 days. Natural waters degradation – half life approx. 4 – 9 days.
Bioaccumulative potential:	May have the potential to bioaccumulate

13: DISPOSAL CONSIDERATIONS

Disposal must be in accordance with local and national legislation.

Unused Product:	Dispose of through an authorised waste contractor to a licensed site. May be incinerated.
Used/Contaminated Product:	Dispose of through an authorised waste contractor to a licensed site. May be incinerated.
Packaging:	Dispose of through an authorised waste contractor. May be steam cleaned and recycled.

14: TRANSPORT INFORMATION

This product is not classified as dangerous for transport.

15: REGULATORY INFORMATION

Classification/Symbol: Not Regulated

This preparation is not classified as Dangerous according to EU Directives

This safety data sheet is intended to assist in compliance with the following UK legislation:

- Chemicals (Hazard Information and Packaging for Supply) Regulations 2002
- Control of Substances Hazardous to Health Regulations 2002.
- Health and Safety at Work, etc. Act 1974.
- Environmental Protection Act 1990
- Environmental Protection (Duty of Care) Regs. 1991
- COSHH essentials: Easy steps to control chemicals. Control of Substances Hazardous to Health Regulations

Further Guidance
The following guidance notes are available from HMSO or HSE.

Occupational exposure limits (EH 40). Effects of mineral oil on the skin (SHW 397).
Preventing dermatitis at work (INDG 233)
A step by step guide to COSHH assessment (HSG 97)
Assessing and managing risks at work from skin exposure to chemical agents (HSG 205)
The selection, use and maintenance of respiratory protective equipment: A practical guide (HSG 53)
Relevant EC Directives:

- Dangerous Substances Directive (DSD)
- Dangerous Preparations Directive (DPD)
- Safety Data Sheets Directive (SDSD)
- Health & Safety Framework Directive

16: OTHER INFORMATION

This data sheet was prepared in accordance with Commission Directive 2001/58/ECand SI 2002 No. 1689 (CHIP 3)

Key References:

- Chemicals (Hazard Information and Packaging for Supply) Regulations 2002
- The compilation of safety data sheets. Approved Code of Practice (third edition)
- Approved supply list (7th Edition). Information approved for the classification and labelling of substances and preparations dangerous for supply. Chemicals (Hazard Information and Packaging for Supply) Regulations 2002
- Approved classification and labelling guide. Chemicals (Hazard Information and Packaging for Supply) Regulations 2002. Guidance on regulations (Fifth edition).
- EH40/2005 Workplace Exposure Limits 2005
- COSHH essentials: Easy steps to control chemicals. Control of Substances Hazardous to Health Regulations
- European Inventory of Existing Commercial Substances (EINECS)

The data and advice given apply when the product is sold for the stated application or applications. The product is not sold as suitable for any other application. Use of the product for applications other than as stated in this sheet may give rise to risks not mentioned in this sheet. You should not use the product other than for the stated application or applications without seeking advice from us.

If you have purchased the product for supply to a third party for use at work, it is your duty to take all necessary steps to secure that any person handling or using this product is provided with the information in this sheet.

If you are an employer, it is your duty to tell your employees and others who may be affected of any hazards described in this sheet and of any precautions that should be taken.

We believe, in good faith and to the best of our knowledge that the preceding information is accurate. However, we give no guarantee or warranty in this respect. The information provided herein may not be adequate for all individuals and/or all situations. The purchaser/user of the product remains responsible for storing, using or dealing with the product safely and in accordance with all applicable laws and regulations.

APPENDIX C

CIRIA C522 Risk Analysis Definitions

6.3 RISK EVALUATION

The purpose of risk evaluation is to decide whether or not risks are acceptable and to determine the need for remedial action. The acceptability of identified risks may depend on who is considering the risks (see Chapter 7). Ultimately, the decision on acceptability of a risk is a balance of the technical reasoning, practicality, perception and cost-benefit.

This stage involves:

- collation and review of the risk-based information for the site
- addressing uncertainty and its effect on judgements regarding risk estimates
- identification of those risks that are considered unacceptable.

6.3.1 Collating and reviewing risk-based information

At this stage it is useful to summarise all the risk-based information for the site and relate the receptors to the relevant contaminants. In effect, this involves a re-examination of the conceptual model in light of new information. For large sites it may be that the site is subdivided into several zones for clarity and ease of assessment.

6.3.2 Addressing uncertainty

Uncertainty should be considered in terms of:

- whether enough data exists to estimate the risks with an acceptable level of confidence
- identification of assumptions and safety factors used in the assessment.

The assumptions and safety factors incorporated into a risk estimation should be examined, and if uncertainty is considered unacceptable then the risk estimation stage is repeated (ie the collection of more site investigation data, see Section 5.3). The cost and benefit of additional risk estimation needs to be balanced against the need for certainty. For some sites, uncertainty may be acceptable, and the costs of additional risk estimation deemed unnecessary. However, further site investigation data and risk assessment may be necessary to achieve a cost-effective remediation strategy.

6.3.3 Identification of unacceptable risks

The following methodology has been developed from an in-house procedure used by Enviros Aspinwall (not published), submitted during the course of this research. This methodology was in turn developed from the "Guide to Risk Assessment and Risk Management for Environmental Protection" (DoE, 1995) and *Draft Statutory Guidance on Contaminated Land* (DoE, 1996). The method presented is an updated and modified version of the Enviros Aspinwall procedure and represents one possible methodology for presenting and evaluation the results of risk estimation.

This method for risk evaluation is a qualitative method of interpreting the output from the risk estimation stage of the assessment. It involves the classification of the:

- magnitude of the potential **consequence** (severity) of risk occurring (Table 6.3)
- magnitude of the **probability** (likelihood) of the risk occurring (Table 6.4).

Table 6.3 *Classification of consequence*

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (note: the definitions of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied.
Medium	Chronic damage to Human Health ("significant harm" as defined in DETR, 2000). Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem. (note: the definitions of ecological systems within Draft Circular on Contaminated Land, DETR , 2000).	Concentrations of a contaminant from site exceed the generic, or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer. Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ("significant harm" as defined in the *Draft Circular on Contaminated Land*, DETR, 2000). Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy (eg foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

Table 6.4 *Classification of probability*

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term

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These classifications are then compared to indicate the risk presented by each pollutant linkage. It is important that this classification is only applied where there is a possibility (which can range from high likelihood to unlikely) of a pollutant linkage existing.

This method can be applied with or without site investigation data and can be used to assess the results of either qualitative or quantitative assessment. **It is recommended that the amount of data and basis of classifications are made clear when reporting such an assessment**. It is often possible to undertake this risk evaluation following the Phase 1 stage of the risk assessment. If site investigation and further risk estimation are then undertaken the evaluation can be revised.

Once the consequence and probability have been classified, these can then be compared (see Table 6.5) to produce a risk category, ranging from "very high risk" to "very low risk". The actions corresponding with this classification is given in Table 6.6. A worked example is presented in Box 6.10.

Table 6.3 shows the classification of consequence. To classify the consequence it is important to bear in mind that the classification does not take into account the probability of the consequence being realised (this is considered in Table 6.4). Therefore, for a particular pollutant linkage it may be necessary to classify more than one consequence. For example, the risk from methane build-up in a building presents a risk of harm both to the building and to human health. Both would be classified as *severe*, but the probability, addressed in the next stage of this methodology, may vary (for example, the building may be unoccupied for most of the time, with only occasional visits – eg a pumping station).

The classification of *severe* relates to short-term (acute) risks only. The *medium* classification relates to chronic harm, which can be classed as "significant harm" (if the assessment is carried out for Part IIA purposes. The *mild* classification also relates to significant chronic harm but applies to less-sensitive receptors. The *minor* classification relates to harm which, while not considered "significant", may have a financial implication (eg phytotoxic effects of contaminants on development landscaping).

It is worth noting that, in theory, both a *severe* and *medium* classification can result in death. The differentiation between the two categories is that *severe* relates to a short-term risk whilst *medium* relates to a long-term risk. Therefore the classification of *severe* should indicate that urgent action is required (urgent action may also be required under the *medium* classification, but usually longer-term actions are sufficient).

The classification gives a guide as to the severity and consequence of identified risks when compared with other risk presented on the site. It is not possible to classify an identified risk as presenting "no-risk", rather "very low risk". This is important, as the acceptability of risk may depend on the viewpoint of the stakeholder concerned. It may be necessary to take action to deal with a risk even if classified as "very low", although these actions may not necessarily be required urgently.

Table 6.5 *Comparison of consequence against probability*

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	**Very high risk**	**High risk**	**Moderate risk**	Moderate/ low risk
	Likely	**High risk**	**Moderate risk**	Moderate/ low risk	Low risk
	Low likelihood	**Moderate risk**	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/ low risk	Low risk	Very low risk	Very low risk

Table 6.6 *Description of the classified risks and likely action required*

Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, if is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

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Box 6.10 *Example of risk evaluation*

A site is used for car parking. The surface is mainly hardstanding, but the quality is not sufficient to prevent infiltration of rainwater. Site investigation has shown that, underlying the hardstanding, the made ground and groundwater (minor aquifer) beneath the made ground contain raised concentrations of toxic metals. The site investigation also encountered several areas of fly-tipped wastes with very high cyanide content (enough to present short-term risks to human health). One such area, bordered by housing, is used for informal recreation, mainly by children.

Therefore the contaminant-pathway-receptor relationship can be summarised as below.

Contaminant	Pathway	Receptor	Consequence of risk being realised	Probability of risk being realised	Risk classification	Risk management action taken
Fly-tipped material with high cyanide content	Direct contact	Humans, mainly children playing on site	Severe	High likelihood	Very high	Immediate removal of fly-tipped material to suitable landfill facility
Toxic metals, for example arsenic and cadmium	Leaching to groundwater (minor aquifer)	Minor aquifer, no local abstractions	Medium	High likelihood	High	Further groundwater monitoring, including perimeter and removal of hotspots of contamination.
Toxic metals, for example arsenic and cadmium	Direct contact	Site workers and visitors during remediation	Medium	Likely	Moderate	Site health and safety plan made allowance for contamination. Site workers were supplied with personal protective equipment and damping down of the site during dry periods was undertaken during remediation.
Toxic metals, for example arsenic and cadmium	Dust	Site workers Residential properties next door to site Site workers and visitors during remediation	Medium	Likely	Moderate	It was considered that damping down of site was sufficient to break this pollutant linkage. Dust monitoring was undertaken on site and at site boundaries to prove this.

Note

The pollutant linkage for residential properties was not assessed in detail, as the measures to address the risk to site workers from contaminated dust were considered sufficient to protect nearby residents.

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